

## ESTIMATION OF POLLUTANT LOAD AND BASIN MANAGEMENT OF KYUNG-AN RIVERS, KOREA

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### ABSTRACT

This study was conducted to collect information needed for the improvement of water quality in Kyung-An River basin. Contributions of different sources to the pollution of water in the river basin during the cropping season were investigated. The following is the summary of the study. Considering the fact that there exist around the basin intensive livestock and relatively high population intensity, the most important source of pollution on the river water was livestock waste-water (LWW), followed by domestic waste-water (DWW). Following are the order of greatness of contribution for river water pollution:

- BOD : LWW (95.6%) > DWW (4.6%) > Nonpoint (0.006%) > IWW (0.0002%)
  - Total N : LWW (81.5%) > Nonpoint (9.3%) > DWW (6.5%) > IWW (6.2%)
  - Total P : LWW (66.3%) > DWW (20.7%) > Nonpoint (6.3%) > IWW (6.2%)
- ( here : IWW stands for Industrial Wastewater)

Accordingly, for the improvement of water quality in the Kyung-An River, adequate management of livestock wastewater, particularly in Pogog-myon area of Yong-In City, where 64% of piggery of the region is concentrated would be very important. The contributions of the different sources pollution of water during the cropping season were investigated. First of all, the study surveyed the contribution of river branches in the pollution of water quality at Kyung-an river. It was in order of Kongiam (25.5%) > Yongin Pollutant Treatment Complex (15.26%) > Shinwon (13.99%) > Buen (11.86%) > Yangji (8.68%) > Yooun (7.43%) > Kwang-ju Pollution Treatment Complex (5.50%) > Osan (5.04%). The hydrological model using mass balance and BOD reduction formula suggested that if the quality of water Yoo-un and Shin-won stream (branch streams of Kyung-an River) which is lowest in the basin is controlled adequately and outlet water from Yong-in pollutant treatment complex is adequately treated, the quality of Kyung-an river will be improved by 90% compared to current level.

**KEYWORDS:** basin management, integrated monitoring, pollutant load, water quality.

### INTRODUCTION

The river water quality in rural areas are made worse than before by the increasing quantity of waste water owing to improving living level, waste water flowing from livestock and industries and non-point sources. The polluted rivers can make damage to the living water and agricultural water. Also, when rivers are located at the upper parts of river basin, these can also ploutte tap water resources. Thus, proper water quality management is very much needed for keeping water quality better. Also given consideration is the deep relationship between the Paldang-Lake and Koreans. The lake is the water resource of capital and the area for self-purification. To keep the lake clean, more effective management methods for small-medium river is essential. At 1960, the law of river was made. Since then, practical river management was implemented. At that time, the main purposes of river management were for flood control and water use. These kinds of management have been carried out until now. As a result of these projectst, the damages of floods were decreased. But the self-purification function of rivers is slowly becoming unpopular, which is serious problems in Korea. Hence, this study was carried out to show the various approaches to managing the Kyung-an river which flow into Paldang-Lake directly. Consequently, result of this study help the way to solve the serious problems of river basin management for water quality in Korea.

### MATERIALS AND METHODS

This study attempted to calculate the pollutant load in Kyung-an river basin. To do this, the unit loads calculated by the Ministry of Environment, Korea and statical data published local governments were used. Calculated Pollutant Loads of point sources and non-point sources can identify the main pollutant source in Kyung-an river basin. And each branch stream in Kyung-an River basin was surveyed to show their influences to the main river. For this, 20 sampling sites were collected and sampling was carried out in 1998. Those were sampled and analysed using Standard Methods made by Korean Ministry of Environment. The flow speed and water quantity of the river were surveyed using buoy methods. The water quality of Kyung-an river was predicted on the basis of water quality and quantity of branch stream at the basin using BOD reduction equation and Mass balance equation. Real data in Kyung-an river were used and compared with model data.

## RESULTS AND DISCUSSION

### *Calculating Pollutant Load at Kyung-an River Basin Based on Unit Loads*

Paldang-Lake is composed of three rivers and Kyung-an is one of them. Many livestock areas and factories are located there. The river flows across two cities- Kwnagju and Yongin. In the process of calculating pollutant loads, the livestock areas located middle part of the basin were found the main pollutant source of Kyung-an river.

**BOD** : LWW (95.6%) > DWW (4.6%) > Nonpoint (0.006%) > IWW (0.0002%)

**Total N** : LWW (81.5%) > Nonpoint (9.3%) > DWW (6.5%) > IWW (6.2%)

**Total P** : LWW (66.3%) > DWW (20.7%) > Nonpoint (6.3%) > IWW (6.2%)

These showed that to improve the water quality of Kyungan river, the strong watershed management of Pogog-myun, Yongin City should be concentrated on the 64% of total livestock area.

### *BOD Concentration and Quantity of Kyung-an River*

BOD(X) and Quantity(Q) were surveyed around Kyung-an river. Yu-un stream located at the middle part of the basin showed small quantity(0.06m<sup>3</sup>/hr) but high BOD concentration (30.6mg/L). The Yong-in Pollutant Treatment Complex was 8.97mg/L, and Shin-won 8.03ppm. This was the same result as that of the effluent water of Yong-in Pollutant Treatment Complex and the livestock areas located at the middle of Kyung-an river basin where the main sources of pollution.

### *Predicted water quality of Kyung-an river using Mass Balance Eq.*

The water quality of Kyung-an main river was determined using complete mixed equation and BOD reduction equation based on the water quality and quantity of branch stream at the basin.

The ability of self-purification was determined by the hydrology, hydrography and bio-physi-chemical characters. So the ability was divided by site and section of the river and appeared by self-purification factor. The deoxidation coefficient k was applied 0.1 which is the representative value of waste water, river and the survey on the environmental capacities by rivers. When the section between sites are two short, BOD reduction could be seen. In such case the distance was disregarded. To show the differences in BOD concentration by flowing, the BOD was calculated down to five decimal places.

According to analysis of the real data and model data, the  $R^2 = 0.9077$ , the correlation was positive and the correlation equation was shown at  $Y = 2.4992X - 4.6516$ .

## CONTRIBUTION RATIO OF BRANCH STREAM AT KYUNG-AN RIVER BASIN

Yu-un stream located at the middle part of the basin was showed the small quantity(0.06m<sup>3</sup>/hr) but high BOD concentration(30.6mg/L). And Yong-in Pollutant Treatment Complex was 8.97mg/L, and Shin-won 8.03ppm. This was the same result as that of the effluent water of Yong-in Pollutant Treatment Complex and the livestock areas located at the middle of Kyung-an river basin, which were the main pollution sources. It was in order of Kongiam (25.5%) > Yong-in Pollutant Treatment Complex (15.26%) > Shinwon (13.99%) > Buen (11.86%) > Yangji (8.68%) > Yoo-un (7.43%) > Kwang-ju Pollution Treatment Complex (5.50%) > Osan (5.04%).

### *1<sup>st</sup> water quality model of Kyung-an river*

This study wanted to predict the water quality of Kyung-an river and Paldang after treating the polluted branch streams using mass balance equation and BOD reduction equation. The treatment meant reduce BOD 90%. This value is average BOD reduction rate using activated sludge process in Korea.

#### *Case 1. When Yu-un Stream Treated*

When the water of Yu-un stream was treated, the predicted BOD value was 2.56mg/L(Calculated using mass balance eq.), and correction value is 1.75(Translated real estimated value using correlation eq.) This value means the water quality of Kyung-an river could be purified by treating the Yu-un river. And Yu-un is the most polluted stream at Kyung-an river basin.

#### *Case 2. When Yong-in and Shin-won stream treated*

In the 2<sup>nd</sup> case, the water quality of Kyungan river was predicted when effluent water from Yongin treatment complex and Shinwon stream was treated. The model value was 2.06mg/L and the real estimated value was 0.50mg/L. This means that this will make water quality level of Kyung-an river from 2<sup>nd</sup> degree to 1<sup>st</sup> grade.

#### *Case 3. When O-san stream treated*

The water quality of Kyungan river was predicted after treating O-san stream that is a slightly polluted. The model value is 2.61mg/L and the real estimated value is 1.87mg/L. This showed that BOD concentration is low but the quantity is high. Hence improving water quality of Kyungan river was not necessary.

**Case 4. When Yoo-un, Shin-won and Yong-in treated**

When the water quality of Yu -un, Shin-won and Yong-in that are located at the middle of Kyung-an river and BOD load is treated very high, the quality could be predicted. The model value of influent water of Paldang-Lake was estimated 1.90mg/L and the real estimated value was 0.10mg/L. Hence, the main sources of pollution of the Kyung-an river are these three rivers. Purifying these water sources would improve, the quality of Kyun-an river 90% better.

**CONCLUSIONS AND PERSPECTIVES**

This study was carried out to identify ways of water quality management of Kyung-an River, which is main resource of drinking water for the Metropolitan area and agri-industrial water flow into the Paldang-Lake. For this study, the water quality and quantity were surveyed in Main river and branch stream. The contribution of every branch stream was also surveyed. The summarised conclusion are as follows ;

## 1. Calculating of Pollute Load at Kyung-an River Basin Based on Unit Loads

- BOD : LWW (95.6%) > DWW (4.6%) > Nonpoint (0.006%) > IWW (0.0002%)
- Total N : LWW (81.5%) > Nonpoint (9.3%) > DWW (6.5%) > IWW (6.2%)
- Total P : LWW (66.3%) > DWW (20.7%) > Nonpoint (6.3%) > IWW (6.2%)

2. The contribution of every stream at Kyungan river basin was surveyed. It was in order of Kongiam (25.5%) > Yong-in Pollutant Treatment Complex (15.26%) > Shin-won (13.99%) > Buen(11.86%) > Yangji(8.68%) > Yooun(7.43%) > Kwang-ju Pollution Treatment Complex (5.50%) > Osan (5.04%).

3. Some of polluted branch stream pollutes the water of Paldang Lake. After predicting the water quality using 1<sup>st</sup> order reaction equation. the quality can be purified more than 90%.

4. In Korea, the main source of pollution at the river basin is livestock. Hence, controlling the livestock waste could result to better water quality will be obtained.

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